



Corrective Measures Study (CMS)
Columbia Manufacturing Company (CMC) Restoration Project
Westfield, Massachusetts



Operations, Maintenance, and Monitoring (OM&M) (Corrective Measures Implementation)

This document summarizes OM&M activities planned to verify the ongoing performance of the final corrective measures selected for the remaining three areas of the site requiring further corrective action – Site-wide Soil, North End Groundwater, and South End Groundwater.

This Corrective Measures Implementation Workplan (CMIWP) describes the final corrective action construction, as well as OM&M activities for the final corrective measures. The CMIWP provides details on the following information:

- **Summary of Final Corrective Measures** – provides an overview of the final corrective measures, including objectives.
- **OM&M** – provides details for soil cover inspections, maintenance of the site-wide groundwater monitoring network, as well as the long-term groundwater monitoring program.
- **Changes to Corrective Action** – provides the basis for modifying the final corrective measures, conditions that would trigger consideration of a contingent remedy, and the requirements for terminating final corrective measures.
- **Reporting** – provides a summary of the reports recommended to document OM&M activities
- **Schedule** – provides a schedule for the next five years of activities
- **Public Involvement Plan** – the public has had input to corrective action remedy selection; maintenance of records at Massachusetts Department of Environment Protection (MA DEP) and United States Environmental Protection Agency (USEPA) are provided for ongoing public involvement

Summary of Final Corrective Measures

The following discussion presents the corrective measures objectives for each of the three remaining areas of concern (AOCs), Site-wide Soil, North End Groundwater, and South End Groundwater, as well as the final plans and specifications for each area. The locations of the corrective measures areas at the site are shown on the [Activity and Use Limitation Area](#) map.



Activity and Use Limitation Area

Site-wide Soil

The corrective measures objectives for the Site-wide Soil are based on the potential for human populations to be exposed to site-related constituents of concern (COCs) as well as on the potential for site COCs to migrate through the soil column and impact site groundwater.

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The corrective measures objectives for Site-wide Soil are as follows:

- Mitigate potential adverse effects to human health by maintaining the cap that provides a barrier between the affected soil and potential contact by people through a vegetative cover, concrete, or asphalt
- Minimize future migration of COCs to groundwater

The final corrective measures selected to accomplish these objectives are:

- Maintain the cap on top of the areas of the site where COCs remain above media protection standards (MPS) in the subsurface soil. The area of the site where corrective measures will be implemented is shown on [Corrective Measures Area for Site-wide Soil](#).
- Establish the following activity and use limitations (AULs):
 - Notice to deed that specified areas are to remain for industrial use only (not for residential redevelopment)
 - Notice to deed that COCs are present in subsurface soil
 - Notice to future owners that a cap is present and must be maintained as such

North End Groundwater

The area where final corrective measures are to be applied to the North End Groundwater is shown on [Corrective Measures Area for North End Groundwater](#). The corrective measures area for North End Groundwater is based on the distribution of trichloroethene (TCE) using December 2009 monitoring results.

The corrective measures objectives for the North End Groundwater are as follows:

- Mitigate potential adverse effects to human health by establishing AULs
- Reduce concentrations of COCs in groundwater to achieve MPS. Details of the development of the MPS are provided in [Site Clean-up Goals](#).



**Corrective Measures Area for
Site-wide Soil**



**Corrective Measures Area for
North End Groundwater**



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The final corrective measures selected to accomplish these objectives include the following:

- Continue short-term operation of the groundwater recovery system.
- Monitor the physical, chemical, and biological processes responsible for the natural attenuation (MNA) of chlorinated volatile organic compounds (VOCs) in groundwater in the northern portion of the site. As part of this action, a contingent remedy may be considered if MNA is unable to meet corrective measures objectives.
- Establish the following AULs:
 - Notice to deed that underlying groundwater is affected by COCs
 - Access restrictions in the form of well-casing locks on monitoring wells in the area of affected groundwater

South End Groundwater

The area where final corrective measures will be applied to the South End Groundwater is shown on [Corrective Measures for South End Groundwater](#). This area is based on the distribution of TCE using May 2009 monitoring results.

The corrective measures objectives for the South End Groundwater are as follows:

- Mitigate potential adverse effects to human health by establishing AULs
- Reduce concentrations of COCs in groundwater to achieve MPS. Details of the development of the MPS are provided in [Site Clean-up Goals](#).

The final corrective measures selected to accomplish these objectives include the following:

- Monitor the physical, chemical, and biological processes responsible for the MNA of chlorinated VOCs (tetrachloroethene [PCE], TCE, and daughter products) and site-specific metals (cadmium, copper, chromium, nickel, and zinc) in groundwater in the southern portion of the site. As part of this action, a contingent remedy may be considered if MNA is unable to meet corrective measures objectives.
- Implement the following AULs:
 - Notice to deed that underlying groundwater is affected by COCs



**Corrective Measures Area for
South End Groundwater**



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- Access restrictions in the form of well-casing locks on monitoring wells in the area of affected groundwater

OM&M

The following discussion provides details regarding the OM&M for each of the three remaining AOCs – Site-wide Soil, North End Groundwater, and South End Groundwater.

Site-wide Soil - Soil Cap Inspection and Maintenance

The soil cap is intended to provide a barrier between the affected subsurface soil and human populations. The soil cap at the site includes a combination of vegetation in some areas of the site and asphalt and concrete in other areas of the site. Inspection of the soil cap will be conducted annually. The soil cap inspection area is shown on [Corrective Measures Area for Site-wide Soil](#). An [Example Inspection Sheet](#) for the soil cover is also provided.

During the soil cap inspection, the inspector will visually observe the soil cap for deficiencies. Specific items that will be noted include significant erosion, rutting, or cracking as well as the general condition of the vegetative, asphalt, or concrete capping materials. A deficiency requiring repair is defined as a breach in the soil cap where direct contact can be made with the underlying subsurface soil.

Photographs will be taken of observed defects. A written or electronic log will be kept documenting the general conditions of the cap. The inspector will make a determination of which deficiencies require repair to maintain the cap function until the next inspection event.

If deficiencies requiring repair are noted, repairs will be made within 60 days. Correction of deficiencies will also be noted in the log.

North End Groundwater – Short-Term Operation of the Recovery System and Groundwater Monitoring Program for MNA

The final corrective measure for the North End Groundwater includes short-term operation of the groundwater recovery system with MNA. Short-term operation of the recovery system will continue to mitigate migration of site groundwater from the property line of the site were concentrations of primary COCs are reported above the MPS (based on the December 2009 sampling event). The groundwater migration system consists of nine recovery wells. As discussed in the [Groundwater Site Restoration Activities \(ICMs and Current Conditions\)](#) and [Support for MNA of Groundwater](#), evaluation of the concentration trends in the North End Groundwater perimeter monitoring wells indicates that lower COC concentration groundwater is present upgradient of the recovery system. Thus, concentrations of primary COCs will begin to decline as the groundwater with lower COC concentrations flows toward the recovery wells. OM&M of the groundwater recovery system will continue as outlined in the [Operations and Maintenance Manual Light Nonaqueous-Phase Liquid \(LNAPL\) Extraction and Groundwater Migration Control System](#). Groundwater recovery will be discontinued when concentrations of the primary COCs of the North End Groundwater fall below the MPS in the perimeter monitoring wells. The [Decision Tree for Discontinuing Short-term](#)

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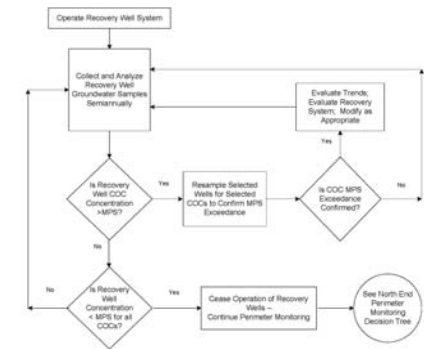
[Groundwater Recovery](#) diagram illustrates when short-term groundwater recovery will be discontinued. Following groundwater recovery, North End Groundwater quality will continue to be restored through MNA.

Groundwater monitoring will be conducted for the North End Groundwater while the short-term groundwater recovery system is in operation, as well as after the system has been shut down. As discussed in the [Site Clean-up Goals](#), the final corrective measure for the North End Groundwater must be protective of potential human exposure to the primary COCs identified in the groundwater through migration of vapors into indoor air. As such, three types of groundwater monitoring will be conducted: compliance monitoring, perimeter monitoring, and off-site monitoring. The purpose of the compliance monitoring system is to ensure the remedy proposed for the North End Groundwater is performing as designed. The purpose of the perimeter detection monitoring system is to provide sentinel monitoring where groundwater exits the site, especially toward the residential area north of the site. The groundwater recovery wells are considered a part of the perimeter monitoring and will be used to monitor the performance of MNA at the property line both during and after their short-term operation. The purpose of the off-site monitoring is to ensure that COCs are not migrating off the site property at concentrations that could pose a risk and that COCs that are present in the off-site wells are attenuating as expected. The MPS for North End Groundwater are provided in [Site Clean-up Goals](#). The completion criteria for the three types of monitoring are described in detail below. AUL notices will remain in effect as long as affected groundwater remains above the federal drinking water standards.

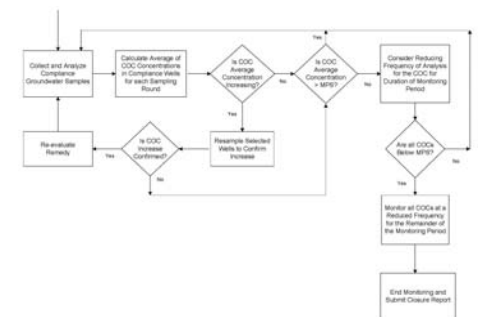
It is anticipated that the current monitoring well network will continue to be sufficient for the ongoing evaluation of site-wide groundwater flow and MNA for North End Groundwater.

Compliance Groundwater Monitoring

Compliance groundwater monitoring wells are defined as those wells located on the site and within, or in the vicinity of, former source areas in the north end of the site. Groundwater samples will be collected from the compliance wells on a semiannual basis. Data obtained from the compliance monitoring network will be evaluated as illustrated on the [Decision Tree for North End Groundwater and South End Compliance Monitoring](#) diagram. As shown on the diagram, concentrations of COCs in the compliance monitoring wells will be averaged and compared against the average concentration observed during the December 2009 baseline sampling event.



Decision Tree for Discontinuing Short-term Groundwater Recovery



Decision Tree for North End Groundwater and South End Groundwater Compliance Monitoring



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If the average concentration for an individual COC has increased, collection of additional groundwater samples from select monitoring wells may be considered to confirm increasing concentration trends observed. In addition, a contingency remedy may be considered should data continue to show increasing concentrations in the compliance monitoring area.

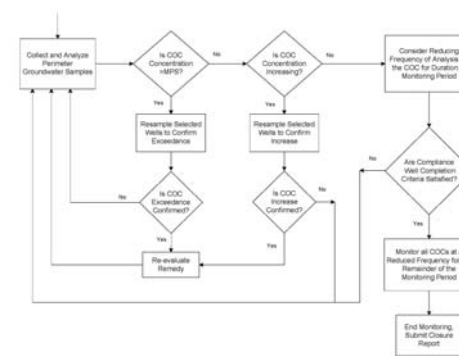
If the average concentration for an individual COC has declined, the compliance monitoring data will be compared to the MPS, and the scope and frequency of future monitoring will be re-evaluated. Proposed changes to the compliance monitoring program will be provided in the annual performance monitoring report.

Perimeter Detection Groundwater Monitoring

Perimeter detection groundwater monitoring wells are defined as those wells located along the property boundary where affected groundwater exits the property. Consistent with compliance groundwater monitoring, groundwater samples will be collected on a semiannual basis. Perimeter detection groundwater monitoring will continue until the corrective measures objectives have been met. Data obtained from the perimeter detection monitoring wells will be evaluated as illustrated on the [Decision Tree for North End Groundwater Perimeter Detection Monitoring](#) diagram.

Concentrations of COCs in each of the perimeter detection monitoring wells will be compared to the MPS. If the concentration in each of the perimeter detection wells for a COC is not below the MPS, the concentration will be confirmed by re-sampling. If concentrations are confirmed to be above the MPS and sampling results show increasing concentrations, a contingent remedy assessment will be considered. Potential contingent remedies are described later in this document. As mentioned earlier in this discussion, the groundwater recovery wells are considered perimeter groundwater monitoring program. As such, samples will be collected from the recovery wells both during and after operation of the recovery system.

If the COC concentrations from the perimeter monitoring wells remain below the MPS criteria and concentrations are not increasing, sampling frequency of all perimeter wells will continue at an annual frequency until the compliance monitoring well performance criteria have been satisfied. Once both the compliance and perimeter monitoring completion criteria have been satisfied, groundwater sampling will continue at a frequency of once every 5 years for the remainder monitoring period.



**Decision Tree for North End Groundwater
Perimeter Detection Monitoring**



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Off-site Groundwater Monitoring

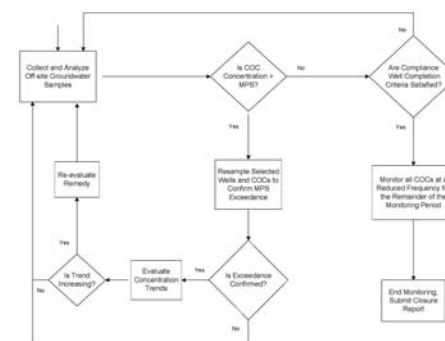
Off-site groundwater monitoring will be initiated concurrent with the compliance and perimeter monitoring described in the above section and will continue until the corrective measures objectives have been met. Data from the off-site monitoring wells will be evaluated as illustrated on the [Decision Tree for North End Groundwater and South End Groundwater Off-site Detection Monitoring](#) diagram.

Concentrations of COCs in each of the off-site monitoring wells will be compared to the MPS. If a concentration observed in an off-site well is above its MPS and increasing, the concentration will be confirmed by re-sampling. If concentrations are confirmed to be above an MPS and increasing, the boundaries of the AUL area will be reviewed and revised as appropriate. The frequency of off-site monitoring will be re-evaluated and concentrations trends will be tracked. If observed concentrations continue to be detected above an MPS, a remedy re-evaluation will be considered. Potential contingent remedies are described later in this document. As of the December 2009 sampling event, COCs are not detected in the off-site monitoring wells at concentrations above the MPS.

If the COC concentrations from the off-site monitoring wells are observed below the MPS, and are not increasing, the sampling frequency of the off-site wells will continue at an annual frequency until the compliance and perimeter monitoring performance criteria have been achieved. Once both the compliance and perimeter monitoring completion criteria have been satisfied, groundwater sampling will continue at a frequency of once every 5 years for the remainder of the monitoring period.

South End Groundwater – Groundwater Monitoring Program for MNA

The final corrective measure for the South End Groundwater is MNA. As a part of this corrective measure, performance groundwater monitoring will be conducted to document that MNA is occurring. Vapor monitoring inside the manufacturing building has shown that the industrial workers employed at the site are not exposed to VOC vapors migrating to the indoor air. Therefore, the primary exposure pathway being addressed by the Final Corrective Measure is exposure of aquatic life through VOCs and/or metals migrating to the surface water of the Little River. As such, two types of groundwater monitoring will be conducted for the South End Groundwater; compliance monitoring (inclusive of all on-site wells in the area of South End Groundwater) and off-site monitoring. The purpose of the compliance monitoring is to ensure the remedy proposed for the South End Groundwater is performing as designed. The purpose of the off-site monitoring is to ensure that COCs are not migrating off the site property at concentrations that could pose a risk to the surface water of the Little River. The MPS for South End Groundwater are provided in [Site Clean-up Goals](#). The completion criteria for the two types of monitoring are described in detail below. AUL notices will remain in effect as long as affected groundwater remains above the federal drinking water standards.



Decision Tree for North End Groundwater and South End Groundwater Off-site Detection Monitoring



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Compliance Groundwater Monitoring

Compliance groundwater monitoring wells are defined as those wells located on the site and/or in the vicinity of, former source areas and along the property line in the south end of the site. Groundwater samples will be collected from the compliance wells on a semiannual basis. Data obtained from the compliance monitoring network will be evaluated as illustrated on the [Decision Tree for North End Groundwater and South End Groundwater Compliance Monitoring](#) diagram. As shown on the diagram, concentrations of COCs in the compliance monitoring wells will be averaged and compared against the average concentration observed during the May 2009 baseline sampling event.

If the average concentration for an individual COC has increased, collection of additional groundwater samples from select monitoring wells may be considered to confirm increasing concentration trends observed. In addition, a contingent remedy may be considered should data continue to show increasing concentrations in the compliance monitoring area.

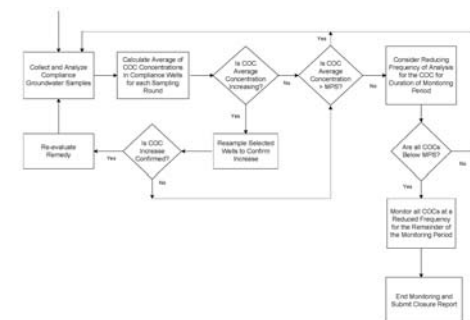
If the average concentration for an individual COC has declined, the compliance monitoring data will be compared to the MPS, and the scope and frequency of future monitoring will be re-evaluated. Proposed changes to the compliance monitoring program will be provided in the annual performance monitoring report.

It is anticipated that the current monitoring well network will continue to be sufficient for the ongoing evaluation of site-wide groundwater flow and MNA for South End Groundwater.

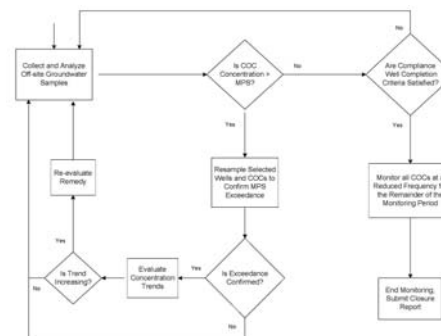
Off-site Groundwater Monitoring

Off-site groundwater monitoring will be initiated concurrent with the compliance monitoring described in the above section and will continue until the corrective measures objectives have been met. Data from the off-site monitoring wells will be evaluated as illustrated on the [Decision Tree for North End Groundwater and South End Groundwater Off-site Detection Monitoring](#) diagram.

Concentrations of COCs in each of the off-site monitoring wells will be compared to the MPS. If a concentration observed in an off-site well is above its MPS and increasing, the concentration will be confirmed by re-sampling. If concentrations are confirmed to be above an MPS and are increasing, the boundaries of the AUL area will be reviewed and revised as appropriate. The frequency of off-site monitoring will be re-evaluated and concentrations trends will be documented. If



Decision Tree for North End Groundwater and South End Groundwater Compliance Monitoring



Decision Tree for North End Groundwater and South End Groundwater Off-site Detection Monitoring

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observed concentrations continue to be detected above the MPS, a remedy re-evaluation may be conducted. Contingent remedies are described later in this document. As of the May 2009 groundwater sampling event, COCs are not detected in the off-site monitoring wells at concentrations above the MPS.

If the COC concentrations from the off-site monitoring wells are observed below the MPS, and are not increasing, the sampling frequency of the off-site wells will continue at an annual frequency until the compliance performance criteria have been achieved. Once the compliance monitoring completion criteria have been satisfied, groundwater sampling will continue at a frequency of once every 5 years for the remainder of the monitoring period.

Groundwater Sampling Program (North End Groundwater and South End Groundwater) and Sampling Procedures

Specific procedures to be used for collecting groundwater samples to monitor water quality are described in USEPA guidance document *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (EISOPQAM; USEPA, November 2001 or most recent revision). Proper sampling techniques are necessary to provide representative samples that have not been altered or contaminated by the sampling procedure.

During each groundwater sampling event, site-wide water level gauging will also be conducted. Water levels will be used to construct a contoured map of the water table, from which groundwater flow conditions can be interpreted. The monitoring well network for the North End Groundwater and South End Groundwater, including the those wells from which groundwater will be sampled and those that will only be used for water level gauging is shown on [North End Groundwater MNA Monitoring Network](#) and [South End Groundwater MNA Monitoring Network](#). [Table 1 \(North End Groundwater Summary of MNA Monitoring Program\)](#) and [Table 2 \(South End Groundwater Summary of MNA Monitoring Program\)](#) summarize recommended monitoring program for the North End Groundwater and South End Groundwater, respectively.



North End Groundwater
MNA Monitoring Network



South End Groundwater
MNA Monitoring Network



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Potential Changes to the Corrective Measures

The following discussion provides information on potential contingent remedies that may be considered should the final corrective measures fail to achieve their objectives. This discussion also includes information regarding potential changes in land use.

Potential Contingent Remedy

Although remaining sources to groundwater have been eliminated through completion of the interim corrective measures (ICMs), alternative corrective measures may be employed as a contingent remedy if the selected corrective measures fail to achieve their objectives (*i.e.*, concentrations of COCs in groundwater increase over time or groundwater plumes expand).

The corrective measures that may be employed as contingent remedies for the Site-wide Soil include *in situ* stabilization and solidification (S/S), excavation and on-site treatment, and excavation and disposal. These corrective measures have been employed at the site as ICMs and have been proven to be effective and easily implementable.

The corrective measures that may be employed as contingent remedies for the North End Groundwater and South End Groundwater include additional groundwater sampling, *in situ* chemical oxidation (ISCO) and groundwater extraction and treatment. ISCO and groundwater extraction and treatment have been implemented successfully at the site as a part of the ICMs.

Contingent remedy assessment may be conducted based on the results of the groundwater monitoring data. A discussion of when a contingent remedy may be considered is provided earlier in this document in the description of the MNA monitoring program.

Changes in Land Use

Future changes in land use may be considered based on the potential needs of future development. These potential changes in land use may result in rendering the selected corrective measures for a particular area inappropriate. MTD will notify USEPA of plans for changes in land use. On an annual basis, the site will be observed for changes in land use. Any unplanned land use changes will be reported as an inspection deficiency.

Reporting

During the OM&M period, an annual summary report will be prepared at year-end following the last monitoring event for each year. Each annual monitoring report will be submitted by March 1 of the following calendar year. The annual reports will include a certification that maintenance of corrective actions and AULs is being continued.



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Groundwater monitoring will occur on a semiannual basis for the corrective measures areas. Groundwater data will be compiled into an annual report. Annual groundwater reports will include the following elements:

- Data collected during the reporting period (water levels, field parameters, laboratory analytical parameters)
- Representative groundwater contour maps depicting groundwater flow patterns and directions for that monitoring period;
- A summation of groundwater quality data and an evaluation of changes in COC concentrations based on the monitoring data;
- A summary of findings and conclusions
- Recommendations for modifications of the groundwater sampling program, as appropriate
- The first annual report will include information on the evaluation of attenuation mechanisms in the both the North End Groundwater and South End Groundwater wells

Cap inspections and well maintenance will be conducted as described previously in this document and the results will be included in the annual report. Inspection logs will include inspection and maintenance activities for the cap, monitoring wells, and monitoring well casing locks. Inspection reports will include the following elements:

- Inspections conducted during the reporting period
- Deficiencies noted during the inspections
- Actions implemented to correct deficiencies

Schedule

The anticipated schedule of activities for the next five years includes semiannual groundwater monitoring for both the North End Groundwater and South End Groundwater and annual inspection and maintenance of the cap. It is anticipated that the annual cap inspection will be conducted concurrently with one of the semiannual groundwater sampling events. The semiannual monitoring and annual cap inspections schedule will be formally developed and communicated upon approval of this CMS. The schedule will also include anticipated timing for submittal of reports to USEPA for their review.

Public Involvement Plan

The CMS provides an opportunity for the public to participate in the corrective action process at the site. Maintenance of records at MA DEP and USEPA are provided for ongoing public involvement. For future public involvement, MTD will maintain a local information repository at public library in Westfield in addition to site information repository.